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**RESPONSE TO THE U.S. EPA COMMENTS  
OPERABLE UNIT 4 TREATABILITY STUDY  
WORK PLAN FOR THE VITRIFICATION OF THE  
RESIDUES FROM SILOS 1, 2, AND 3**

**X/X/XX**

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**ENCLOSURE**

**Response to the U.S. EPA Comments**  
**Operable Unit 4 Treatability Study Work Plan**  
**for the Vitrification of the Residues**  
**from Silos 1, 2, and 3**

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General Comments

1. U.S. EPA Comment: The time sequence allowed for testing radon emanations and off-gassing collection after the residue material was vitrified. The study should indicate if there are radon emanations and off-gassing after 7 days and 30 days or justify why this time sequence testing is not necessary.

Response: Will modify. The Work Plan will specify that the radon emanation from the vitrified waste will be measured at a minimum after 7 days and 30 days. The radon emanation will not be measured for the Sequence C vitrified material. The metal oxide material composition does not warrant a radon emanation test.

2. U.S. EPA Comment: The work plan should consider alternative cooling and material molding methods that could reduce radon emanation and off-gassing after the residues are vitrified.

Response: No change required. Information collected as part of this treatability study, especially concerning the off-gas, will be utilized during the remedy design phase and during preparation of the design documents to determine the most beneficial cooling and molding methods with respect to the radon.

3. U.S. EPA Comment: The work plan did not propose a study of how vitrification affects the radiation dose rates of the residue material which needs to be justified why this was omitted from the work plan.

Response: No change required. The vitrified waste form will be measured for radon emanation. This will reflect how vitrification will affect dose rates with respect to radon.

Also, surface radiation dose rates are a function of concentration self-shielding and external shielding. Worker protection and disposal facility design will address external shielding requirements. Radiation dose of the vitrified product will be measured for input to engineering design but is not considered key input for remedial alternative selection.

4. U.S. EPA Comment: The work plan did not indicate what treatment methods will be considered for the off-gassing waste stream and whether the treatment methodology will impact the off-gassing collection system which needs to be considered in the design of the collection system.

Response: No change required. Information collected as part of this treatability study, especially concerning the off-gas, will be utilized during the remedy design phase and during preparation of the design documents to determine the most beneficial treatment method of the off-gas.

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5. U.S. EPA Comment: The work plan provides minimal detail regarding testing and analytical procedures. This lack of detail makes the work plan difficult to review and may lead to additional review comments in these areas when a revised work plan is submitted.

Response: No change required at this time. Testing and analytical procedures are in the process of being prepared by PNL and will be submitted when available.

6. U.S. EPA Comment: No details are provided about the off-gas equipment to be used in the bench-scale testing. According to Subsection 4.2.1, Pacific Northwest Laboratory (PNL) will test and modify the equipment previously used for vitrification testing before the equipment is used in the bench-scale testing. (See specific comment No. 14, which points out that this section is very confusing). The work plan should provide information about the equipment used in previous testing and the plans for modification. This information should describe the methods by which the off-gas is condensed (if at all), how the gas volume is measured, and how the gas samples are collected.

Response: Will modify. A figure will be added identifying the equipment that will be used. The equipment list in Section 5.0 will be expanded. Off-gas will be sampled and composition will be determined.

7. U.S. EPA Comment: The work plan does not provide detection limits and specific test methods of analyses (for such parameters as percent moisture, volume of off-gas, composition of off-gas). Appendix A to the work plan (PNL Project QA Plan) referenced in Section 7.0 does not address any of these issues.

Response: Will modify. Reference to procedures will be added to Section 3.3. Non-standard procedures are in the process of being developed by PNL and will be submitted when available.

8. U.S. EPA Comment: The test plan does not include the collection of baseline data on leachability and radon emanation from untreated wastes samples for comparison against vitrified product samples. These two measurements are necessary in order to draw conclusions about the effectiveness of treating the waste material by vitrification. These parameters should be added to the treatability test data objectives, and collection of this data should be described in the work plan.

Response: Will modify. Baseline data on leachability is being collected as part of the K-65 residue characteristic sampling program. Therefore, TCLP analysis will not be performed on the untreated waste as part of this work plan.

Radon emanation on data will be collected on the untreated K-65 residues as part of this work plan.

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9. U.S. EPA Comment: The work plan does not state how vitrification will be implemented at the site, such as in-situ vitrification or ex-situ vitrification. Therefore, it is difficult to assess whether the testing procedures represented in the work plan adequately represent the effectiveness of the vitrification treatment alternative and its implementability at the site.

Response: No change required. Vitrification will not be implemented as in-situ vitrification. In discussion of vitrification technologies, the terminology is either in-situ vitrification or vitrification.

#### Specific Comments

1. U.S. EPA Comment: Section 4.2.5., Page 34, Sequence D:

This test sequence utilizes K-65 material and Silo 3 metal oxide material, but does not consider the Bento-grout aspect in the K-65 material that could influence the 70/30 mix ratio for vitrification testing. Justify why this was omitted.

Response: No change required. It is premature to evaluate the role of Bento-grout in a proposed vitrification of K-65 and Silo 3 material. It is not known nor is it assumed that the mixture of K-65 and Silo 3 material will easily vitrify. If an incompatibility of this mixture is determined during laboratory screening tests, further studies will not be conducted. If the material can be vitrified, this issue will then be evaluated.

2. U.S. EPA Comment: Subsection 1.1, pages 1 and 2: This work plan would be improved by the addition of a more complete physical and chemical characterization of the wastes in the silos. Specifically, the inorganic chemical characterization of the wastes are very relevant to the test plan. In addition, information concerning the organic make-up of the waste materials needs to be presented to completely evaluate the work plan.

Response: Will modify. An appendix will be added that will include the characterization data of the wastes in the silos.

3. U.S. EPA Comment: Subsection 1.1, Page 2, line 31: The work plan states that the primary purpose of the remedial action objectives (RAO) is to ensure compliance with chemical-specific applicable relevant and appropriate requirements (ARAR) and to-be-considered (TBC) guidelines. However, the chemical-specific ARARs and TBC guidelines are not presented in the work plan. The chemical-specific ARARs and TBC guidelines should be presented to demonstrate that the detection limits for the treatability analyses are low enough to evaluate the effectiveness of vitrification and to meet the RAOs.

Response: No change required. Remedial Action Objectives (RAOs) with respect to the ARARs are the overall remedial objectives. The goals of the treatability study are included in Section 1.4. During the detailed analysis of alternatives phase of the RI/FS, all remedial alternatives will be evaluated as discussed in Section 1.3.2 of the work plan.

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4. U.S. EPA Comment: Subsection 1.3.1, page 7, lines 5 and 6 (Table 1-1, page 8): Correct the composition of the off-gas provided in the table so that the sum total adds up to 100 percent.

Response: No change required. Data reported in Table 1-1 was the data as submitted by the laboratory where the analysis was performed as part of the previous K-65 residue vitrification studies.

5. U.S. EPA Comment: 1.3.4, page 13, lines 20 to 23: A determination of the total volume of the liquid condensate produced from the off-gas should be added to the list of results to be verified. The volume of condensate produced could impact the feasibility of vitrification. For example, the amount of condensate may impact the implementability or cost of the alternative. This parameter should be added to all other relevant sections of the test plan that discuss collection of data, including Sections 3.0, 4.0, 6.0, 7.0, and 8.0.

Response: No change required. The volume of condensate produced does not affect the feasibility of the vitrification treatment option. The amount of condensate could impact the size of the remedial plant. The implementability and cost of the alternative impacts concerning the volume of condensate will be determined during remedy design. During the vitrification process, it is anticipated that the condensate will be recycled through the vitrification process.

6. U.S. EPA Comment: Subsection 2.2, page 22, line 4: The work plan states that treatability testing will be conducted to determine the long-term stability of the vitrified waste materials. Information should be presented concerning the types of testing that will be conducted to evaluate long-term stability, such as wet/dry weathering tests or freeze/thaw weathering tests.

Response: No change required. Vitrification of radioactive waste has been identified as a Best Demonstrated Available Technology (BDAT). As stated in the Operable Unit 1 Response to comments on the OU 1 Treatability Study Work Plan, tests relating to the long-term stability, e.g., freeze-thaw and wetting and drying tests should be conducted during the remedy design phase. Also, it should be noted that tests related to the long-term stability of the vitrified waste form will not be performed because durability was established when vitrification was promulgated as BDAT.

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7. U.S. EPA Comment: Subsection 3.1, pages 23, lines 28, 30 and 32: State that bulk density, percent moisture, and specific gravity measurements will be performed on raw waste samples.

Response: Will modify. Added "of untreated wastes".

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8. U.S. EPA Comment: Subsection 3.1, page 24, line 9: State that specific gravity of the vitrified product will be measured.

Response: Will modify. Specific gravity of vitrified waste added.

9. U.S. EPA Comment: Subsection 3.1 pages 23 and 24: Include objectives that address measurement of total condensate volume, toxicity characteristic leaching procedure (TCLP) analysis of raw waste samples, radon emanation from raw waste samples, and all analysis of liquid samples.

Response: Will modify. Section 3.0 will include references to radon emanation from raw waste and analysis of condensate. See comment #8 for TCLP and comment #5 for total condensate volume.

10. U.S. EPA Comment: Subsection 3.2, page 26, Table 3-2: For laboratory screening, add the data quality objective (DQO) for physical property testing.

Response: Will modify. Physical property test procedure will be referenced in Section 3.0.

11. U.S. EPA Comment: Subsection 4.1, page 27, lines 23 and 24: Clarify why the samples used previously for vitrification testing were not representative of material in Silos 1 and 2. Qualify the data provided in Table 1-1 with a statement regarding the representativeness of the samples.

Response: Will modify. The samples used previously for vitrifications testing were not judged to be representative of all the material in Silos 1 and 2 since this sample was from the 1989 sampling effort. It is understood that most of this sample came from Zone A. Current vitrification samples are identified as Zone A, B and C, as well as a composite, and are, therefore, considered representative.

12. U.S. EPA Comment: Subsection 4.2, page 30, lines 15 to 17: The work plan states that determining the composition of the off-gas generated will focus on quantifying the amount of radon generated. However, Table 1-1 on page 8 of the work plan indicates that the condensate contains low concentrations of relatively volatile metals, including lead and mercury. Treatability testing should also evaluate the potential for metals in the off-gas.

Response: No change required. The potential for metals in the off-gas is being evaluated by analyzing the condensate. Other large vitrification efforts, such as at Hanford, are evaluating this concern by sampling deposits in the off-gas line of pilot scale tests. Further evaluation of metals in OU 4 vitrification of off-gasses (beyond condensate analyses) should wait until pilot scale tests are performed.

13. U.S. EPA Comment: Subsection 4.2, page 30, lines 19 to 37: The text should explain the difference between open system testing and partial system testing.

Response: Will modify "Partial" should be "open".

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14. U.S. EPA Comment: Subsection 4.2.1, page 33, lines 9 to 18: Expand and clarify this paragraph. Provide details on the proposed off-gas collection system, explain why modifications are expected, and list items of the system that may be modified.

Response: Will modify. Paragraph will be revised to clearly state that the volume of the off-gas will not be collected and measured and that radon monitoring will be performed utilizing an open system.

15. U.S. EPA Comment: Subsection 4.2.2, page 33, lines 22 and 23: This is the first reference in the document to the proposed use of "glass forming reagents." Modify the text to identify the reagents, estimate the quantities to be used, and explain why they are required.

Response: Will modify. Sections 4.2.2, 4.2.3, 4.2.4 and 4.2.5 will be clarified on the addition of glass forming reagents.

16. U.S. EPA Comment: Subsection 4.2.4, page 34, line 7: Provide a detailed explanation of the "PNL specific criteria for vitrification."

Response: Will modify. A paragraph will be added defining the PNL specific criteria for vitrification.

17. U.S. EPA Comment: Subsection 4.2.4, page 34, lines 39 to 41: Justify the selection of the constituents on the basis of RAOs or the list of proposed constituents of concern.

Response: No change required. Based on the available EP toxicity data (Buel, 1989) for the unvitified waste, all of the heavy metals from the EP toxicity list, with the exception of lead, were below the regulatory limits.

18. U.S. EPA Comment: Subsection 4.2.5, page 34: PNL intends to mix waste materials from the metal oxide silo with the waste materials from the K-65 silos for vitrification testing. The work plan should discuss the comparability of these two waste materials, and the evaluation of the vitrification alternative should consider waste compatibility when determining its short-term effectiveness in the feasibility study.

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Response: Will modify. The mixture of K-65 material and Silo 3 material has been proposed for the purpose of reducing costs of remediation. It is not known nor is it assumed that the mixture will easily vitrify. A determination of compatibility for vitrification will be made during laboratory screening tests.

19. U.S. EPA Comment: Subsection 8.3: The work plan specifies that data will be presented for the "amount of water added to form a 45 percent moisture content slurry." If moisture will be added to the samples during bench-scale testing, this procedure should be clearly described in Section 4.0 along with a justification for doing so. Excessive moisture is a concern in materials to be vitrified, because steam collection from the center of the vitrified mass must be controlled during full-scale treatment.

Response: No change required. The more homogenous the feed material is to the melter, the more efficient the vitrification process is. The addition of water to form a slurry is the standard process for vitrification of high level radioactive material. This is not an in-situ vitrification process. Excessive moisture is a concern in materials to be vitrified during in-situ vitrification.